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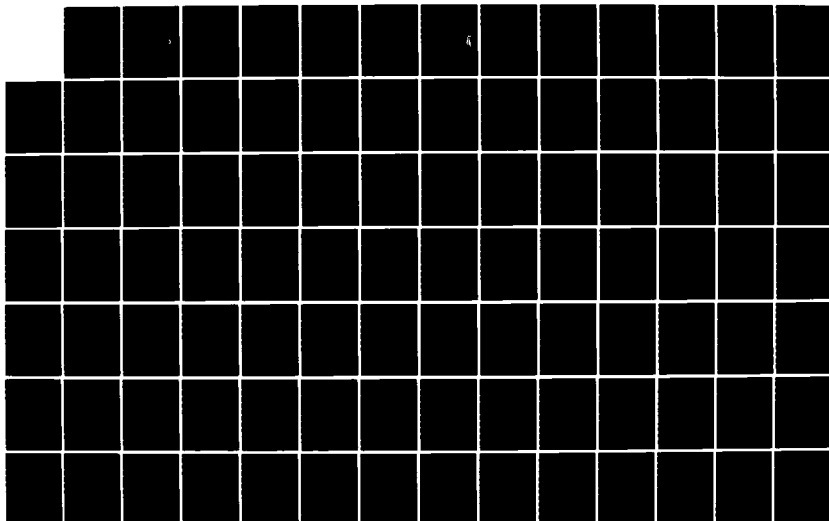
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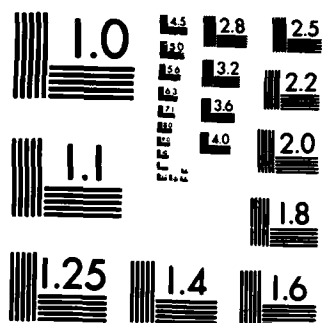
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Title of Dissertation: Persistence Differences between the Three Mile  
Island Residents and a Control Group

Daniel L. Collins, Capt, USAF: Doctor of Philosophy, 1984

Dissertation directed by: Andrew S. Baum, Ph.D., Department of Medical  
Psychology

ABSTRACT

A nuclear accident occurred at Three Mile Island (TMI) on  
March 28, 1979. ~~The aftermath of this incident remains unresolved.~~  
The cleanup activities have been progressing for the last 5 years and  
have been a source of stress for TMI residents, exacerbated by  
conflicting reports regarding how and when the damaged nuclear material  
would be removed. The purpose of this study was to compare TMI residents  
to a demographically similar control group to determine (1) if the  
chronic stress experience by TMI residents would influence persistence  
on two experimental tasks, and (2) whether effects on task persistence  
would vary depending upon individual coping style and degree of  
behavioral involvement with the tasks. All subjects resided within  
sight of the damaged nuclear power plant at TMI. The control group  
subjects were from Frederick, Maryland located over eighty miles away.

The specific variables investigated were level of involvement  
(i.e., high or low) and coping style (i.e., High-Control-Oriented or  
Low-Control-Oriented). On two chance tasks (i.e., a dice task and a  
calculator task) subjects predicted the next 2-digit number that would

appear when either a pair of dice was rolled or when a calculator randomly generated the numbers. Each subject performed both tasks and was highly involved in one task and in the low involvement condition in the other task. In the high involvement condition, subjects physically rolled the dice or started the calculator whereas, in the low involvement condition the experimenter, not the subject, performed the physical portion of the task. The total number of trials completed was the measure of persistence. The order of both the tasks and the involvement conditions was randomized for all subjects. Furthermore, whether a subject chose to roll the dice by hand or use a dice cup was recorded by the experimenter and compared for both groups (i.e., TMI vs control).

It was hypothesized that the TMI residents would exhibit significantly less persistence on the chance tasks than would the control group. Furthermore, ~~It~~ it was anticipated that in the low involvement condition all subjects would show significantly less persistence than in the high involvement condition. The method selected to roll the dice (i.e., hand or cup) was expected to be significantly different between the TMI and Frederick groups, with more TMI subjects choosing to roll the dice by hand. Subjects with a High-Control-Oriented coping style were expected to persist longer than those subjects with a Low-Control-Oriented coping style.

All these hypotheses were confirmed except one. The hypothesized differences between coping styles showed no main effect. These findings suggest a number of conclusions. First, living near TMI appears to have affected the behavior of these residents. This was demonstrated by the

behaviors of the Three Mile Island residents who exhibited less persistence on the chance tasks than did comparison subjects. The choice of method of dice rolling used by the residents of TMI was significantly different than that used by the subjects at the control group. These responses appear to be related to the TMI resident's experiences with chronic stress and other influences in their environment.

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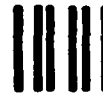
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PERSISTENCE DIFFERENCES  
BETWEEN THE THREE MILE ISLAND RESIDENTS  
AND  
A CONTROL GROUP

by

Daniel L. Collins  
Captain, USAF

Dissertation submitted to the Faculty of the Department of  
Medical Psychology Graduate Program of the  
Uniformed Services University of the Health Sciences  
in partial fulfillment of the requirements for the degree  
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## Introduction

Scientific interest in stress has derived from several disciplines, including medicine, psychology, endocrinology, and physiology. Despite this multidisciplinary background, there are two basic traditions of stress research. One evolved from a biological perspective (Selye, 1936, 1955, 1976), based on research in endocrinology and physiology. The other derives from the psychosocial tradition (Jenkins, 1979; Kagan & Levi, 1974; Levi, 1972; Nuckolls, Cassel & Kaplan, 1972). The psychosocial tradition views both external and internal events as parts of a stress process and emphasizes the interaction between environment and response (Lazarus, 1966; Lazarus & Launier, 1978; Mason, 1975). Stress has been defined as the process by which environmental events threaten or challenge an organism's well-being and by which that organism responds to this threat (Baum, Singer, and Baum, 1981). The environmental events are called stressors. Thus, stress can be conceptualized as a process that results from the relationship between people (or an organism) and their surroundings.

### History of Stress

The concept of stress is not new. From an historical perspective it should be noted that Hippocrates used the term "pathos" to describe pain and suffering, and "ponos" to refer to the toll of resisting the pathos caused by undesirable or threatening circumstances (Gatchel & Baum, 1983). This interactive concept is referred to as monism.

Very little additional knowledge regarding stress resulted until the 20th century, when Cannon (1915) suggested that the term "stress" involved both a psychological and a physiological component. He is

credited with suggesting that the term stress be used to describe interactions between mind and body (1914). Cannon (1929) also described the now famous "fight or flight" response, which involved the psychological perception of danger and the body's preparatory physiological response (i.e., release of epinephrine by the adrenal medulla) to increase the organism's probability of surviving a threatening occurrence. Cannon (1932) reiterated and expanded this concept in his classic work, "The Wisdom of the Body". Three years later, in 1935, Cannon's physiological concept of stress was summarized in an essay entitled "Stresses and Strains of Homeostasis." In this manuscript, he used an engineering concept of strain and stress in a psychophysiological context. He referred to "great emotional stress" as a potential cause of medical problems and felt strongly that emotional stress could cause disturbances of a physiological nature (Cannon, 1935). He argued that this perspective is important because it offers "insight into the strength and endurance of an organism and thus, reflects its ability to resist the operation of disturbing forces" (Cannon, 1935). Thus, it was as a result of Cannon's research that the concept of stress became formalized. Furthermore, Cannon's insistence on psychological aspects of the stress response makes his view compatible with more recent theories of stress (see Frankenhaeuser, 1971; Mason, 1971, 1975). However, in order to provide chronological integrity -- before discussing Frankenhaeuser's and Mason's stress research -- a discussion of Selye's theory of stress is necessary.

#### Selye's Biologic Theory of Stress

Selye's stress research has done much to popularize the concept of stress across many disciplines. Selye's forty years of stress research began accidentally, when he noticed that injections of sex

hormone extracts resulted in a triad of responses. Selye observed that as a result of these and other biological insults, the laboratory animals had developed hypertrophied adrenal glands, atrophied thymus and lymph glands, and gastrointestinal ulcers. Selye also discovered that these physiological sequelae occurred using other physiological stressors such as croton oil. Selye's stress research was based upon this triad of physiological responses.

In order to describe the processes that might lead to this triad of responses, Selye (1946) devised the General Adaptation Syndrome (GAS). The GAS is a nonspecific syndrome, because any stressor will trigger the same series of responses. The GAS consists of three stages. The first stage is called the alarm stage. During this phase the organism responds by mobilizing its reserves to combat the threat imposed by the physical demands of the stressor. After the body's reserves have been made ready, it enters the stage of resistance. It is during this stage that the organism appears to be maintaining its own against the stressor. Typically, the organism achieves suitable coping with and resistance to the stressor during this stage. Thus, it resists and overcomes the stressor, and its physiological state returns to normal. However, if the stressor is repeated, prolonged, or sufficiently strong, the organisms adaptive resources may be diminished and their ability to resist further depleted. Selye termed this stage exhaustion. The result of exhaustion is likely to be the onset of illnesses such as cardiovascular disease and arthritis.

Selye's research allowed for psychological activation of the GAS. However, this was a minor part of his theory and consequently no attempt

was made by Selye to discriminate between responses of a psychological or physiological origin. Nonetheless, Selye's biological model of stress was significant in several ways. First, he suggested that the triad of responses exhibited by the organism occurred regardless of the stressor. His theory of non-specificity evolved from these observations (Selye, 1976). Second, he suggested that the effects of stressors are cumulative in exerting the physiological toll. This cumulative effect is exemplified by the exhaustion phase of the GAS. Third, Selye suggested that the stress response was regulated by the Pituitary - Adrenal - Cortical (PAC) axis. This observation provided the initial thrust for studying the adrenal cortex as a central component of stress. Unfortunately, attention was focused on the cortex to the exclusion of the adrenal medulla. Although Selye contributed to our knowledge of stress, per se, modern researchers have questioned the robustness of portions of his theory.

#### Integrative Theories of Stress

Several scientists (Adler, 1943; Ax, 1953; Mason, 1968a, 1968b, 1971, 1975; Poe, Rose, & Mason, 1970; Rose, Poe, & Mason, 1968; Symington, Currie, Curran, & Davidson, 1955) have argued that the relationship between emotional arousal and physiological response is more complex than Selye suggested and that psychological activation may be a necessary part of stress. Symington et al. (1955) demonstrated that hypertrophied adrenal glands were noted -- only if cognitive processing of the stressor occurred. Symington et al. (1955) contrasted two groups of dying patients; one group consisted of people who were comatose until they died, the other group was made up of patients who



remained conscious until they passed away. Autopsies showed that the conscious group had enlarged adrenal glands compared to an unconscious group. The enlarged adrenal glands were indicative of a heightened stress response. This suggests that conscious mental involvement (i.e., conscious group) was necessary for the stress response to occur.

A similar effect was reported in a study of survivors of the Cocoanut Grove fire (Adler, 1943). This fire broke out in a large dinner club filled with patrons. Unfortunately, many people were unable to escape because of inadequate fire exits and the rapidly spreading fire. Consequently, many people were trapped, panic ensued, and many passed out and died as result of smoke inhalation. The people who lost consciousness shortly after the fire began -- and were subsequently dragged out by firemen -- experienced fewer psychological and somatic complaints than did the people who were conscious and fearful throughout the debacle (Adler, 1943).

Additional evidence that psychological awareness of noxious events may be necessary for stress to occur comes from Mason's (1975) research. Mason questioned Selye's GAS thesis, arguing that stress is neither nonspecific, nor is it unitary, that is, psychosocial stimuli mediate the stress response. Mason's (1975) work has shown that physical stressors, such as elevated ambient temperatures, do not elicit adrenal activity when the psychological components of perception and sensation of the stressor are eliminated. This was demonstrated by regulating the perception of temperature changes so that in one condition it was viewed as threatening, while in another the temperature change was not threatening (Mason, 1975). Furthermore, Mason demonstrated that when stressors varied in uncertainty, fear, or anger, different

patterns of corticosteroid, epinephrine, and norepinephrine activity emerged. Mason noted multiple hormonal responses in normal young men anticipating an exhaustive exercise period. He found a specific pattern of elevated plasma cortisol and norepinephrine levels, with little or no increase in epinephrine levels. This response pattern, referred to as Pattern I was consistent with another series of experiments, wherein monkeys knew exactly what was forthcoming -- due to the experimentally manipulated conditioning paradigm (Mason, Mangan, Brady, Conrad, & Rioch, 1961; Mason, Brady, & Tolson, 1966). Conversely, when the animals were alerted to possible unpleasant events but did not know exactly what the events would be or when to expect them, the Pattern II response -- elevated levels of corticosteroids and both epinephrine and norepinephrine -- was noted.

Mason (1975), unlike Selye (1976), suggested that psychological distress precedes adrenal-pituitary responses and may be necessary for a physiological reaction to occur. Furthermore, Mason (1975) demonstrated that the context in which the psychosocial stressor is presented (i.e., uncertain vs predictable) can determine a specific type of adrenal gland response -- Pattern I or Pattern II. Thus, Mason demonstrated the role of psychosocial stimuli in mediating the activity of the adrenal glands.

The Swedish laboratory of Frankenhaeuser has also contributed in several ways to further our knowledge of the stress process. First, Frankenhaeuser and her colleagues have demonstrated the pervasive role of psychological factors in eliciting the stress response. In one study, epinephrine and norepinephrine levels increased with decreased levels of control over an electric shock (Frankenhaeuser & Rissler, 1970). In other studies, having too much or too little to do resulted

in heightened neuroendocrine activity (Frankenhaeuser, Nordheden, Myrsten & Post, 1971; Frankenhaeuser & Gardell, 1976). These studies demonstrated that the neuroendocrine system is responsive to purely psychological events and that cognitive and emotional functioning are, in turn, affected by the stress response (Frankenhaeuser, 1972). She explained her findings by integrating Cannon's and Selye's concepts of stress. Cannon viewed the stress process as consisting of a psychological and a physiological component. Frankenhaeuser (1971, 1972, 1977, 1978, 1980) has expanded upon these concepts of stress by demonstrating the interdependent nature of the psychological and physiological components, as well as how they affect each other. The consistency of adrenal response activity to varied types of psychological stimuli including loss of control, urban commuting, job satisfaction, boredom, conflict, and anticipation of an event (Collins & Frankenhaeuser, 1978; Frankenhaeuser, 1972; 1977; 1978; Johansson, 1977; Lundberg & Frankenhaeuser, 1976; Singer, Lundberg, and Frankenhaeuser, 1978) suggests a kind of nonspecific responsiveness similar to Selye's. From Frankenhaeuser's integrative work on stress, we can conclude that a complex psychological and physiological response is evoked in responding to a stressor.

#### The Stress Process

Stress was previously defined as "the process by which environmental events threaten or challenge an organism's well-being and by which that organism responds to this threat" (Baum, Singer, & Baum, 1981). A comprehensive view of the stress process includes three components: a source, a transmission, and a response (Baum, Singer & Baum, 1981). These three components are interactive. The source of

the stress response is a stressor, and has transmission characteristics -- which the organism appraises. The stressor can initially be a physiological trauma (i.e., rapidly withdrawing from a hot stove) or a psychological threat (i.e., death of a loved one). However, the stressor must be appraised as stressful before the recipient exhibits the sequelae of the stress response (Lazarus, 1966). When a stressful appraisal of the stressor is made, the ensuing stress response is commonly associated with symptoms such as anxiety, fear, and anger. It follows, that the intensity or duration of a stress response could be ameliorated by the recipient's appraisal of the stressor.

Support for the importance of the appraisal process is found in the classic work of Schachter and Singer (1962). These author's showed that depending upon how an individual appraised environmental events could in turn affect their emotional states. Schachter and Singer (1962) manipulated, by using a confederate, either a positive (i.e., happy, funny) or negative (i.e., grouching, hostile) environment. They found that individuals reflected the artificially created environment of their particular experimental condition.

The most common measures of the stress response allow inferences about emotional states by assessing physiological reactivity. This has been done by measuring muscle potential changes, skin conductance, and cardiovascular reactivity (e.g., blood pressure, heart rate) and systematic reactions caused by increased levels of catecholamines and corticosteroids. Frankenhaeuser, (1975) has directly measured levels of these hormones in the blood and urine. The stress response at these levels of measurement appears to be fairly similar, consistent, and non-specific (Selye, 1955, 1976).

However, as Mason (1975), Frankenhaeuser (1975), and others have shown -- depending upon one's appraisal of the stressor -- a different patterning of endocrine responses can, and does, occur. Thus, the stress response can be initiated by psychological or physiological stressors. Furthermore, the recipient's response to the stressor may be both specific and nonspecific, depending upon one's appraisal of the stressor.

#### Appraisal

A series of studies conducted by Lazarus and his associates during the 1960's demonstrated the important role of the appraisal process. One such study had subjects view a stressful film. During this film gruesome woodshop accidents were depicted -- such as a worker being killed by a wooden plank being driven through his body, or a worker cutting off his finger (Lazarus, Opton, Nomikos, and Rankin, 1965). Each viewer was connected to a polygraph and peripheral cardiovascular and electrodermal responses were recorded. The intensity of these responses and level of perceived stress depended upon which of three sound tracks was used. For one group the film was presented as staged; for another it was presented as an authentic depiction of events -- to increase safety awareness; for a third group no instructions were provided. When the subjects' appraisal of the film was manipulated by giving them instructions that focused their attention on the technical nature of the film, there were minimal or no effects. This was attributed to their appraisal of the film in a less threatening manner than either the group that was asked to concentrate on the accident or the group that received no instructions and consequently thought the carnage was real (Lazarus et al., 1965).

Lazarus' results were similar to an earlier study, in which subjects were shown a film consisting of crude genital surgery which represented the initiation rites of a primitive Australian culture (Speisman, Lazarus, Mordkoff, & Davison, 1964). Three narratives were used to maximize one of three experimental manipulations. The conditions established the circumcision as an aloof and detached presentation of anthropological interest (intellectualization condition), an instance of mutilation and potential disease (trauma condition), or a happy and willing rite of passage (denial condition). Once again the subjects in the trauma condition perceived the film as more stressful than did subjects in either the denial or intellectualization condition. This study demonstrated that stress is not well defined in situational terms alone -- since all subjects saw the same film but differentially responded to the experimental conditions. Additionally, Speisman et al. (1964) found that subjects predisposed to use intellectualization as a measure of coping with aversive events showed more stress in response to the denial sound track than to the intellectualization soundtrack. The opposite was true of those who tended to cope by denying a threat. Thus, differences in appraisal were again found to be responsible for variations in the intensity of the stress response.

The significance of these studies is not that the appraisal of threat can be influenced but that such appraisals underlie the actual experience of threat. The stress response begins when the individual appraises some important value or notion as being threatening. Lazarus (1966) notes that "the appraisal of threat is not a simple perception of the elements of the situation, but a judgement, an inference in which the data are assimilated to a constellation of ideas and expectations."

As was described by Lazarus (1965) and his colleagues (Speisman et al., 1964) the same stimulus event will be appraised as threatening by some individuals and not by other individuals. Given that the stimulus event is perceived as threatening, an individual then engages in secondary appraisal. The difference between primary and secondary appraisal is that the latter is concerned with an evaluation of consequences of actions taken to minimize the threat. An example of primary appraisal is -- "how much am I in danger from this situation?"; whereas, with secondary appraisal, the issue is "how much am I in danger from anything I do about the threat or to what extent will any particular action relieve the danger?" (Lazarus, 1966). Primary and secondary appraisal are not necessarily sequential, but the later does depend on the former. Secondary appraisal is necessary in order to understand why certain individuals may become angry, whereas other individuals may become depressed, or exhibit grief, or sadness. Secondary appraisal is inextricably linked to the coping strategies which follow the appraisal process.

Therefore, a key to the stress process is in an individual's "appraisal" of the stressor (Lazarus, 1966; Mason, 1975). The nature of the stressor is evaluated in terms of the probability and severity of its consequences. This evaluation is consistent with Lewin's (1936) concept of teleology -- a purposive interpretation of the present situation, in terms of both future contingencies and past events. When these and other aspects of the situation -- one's ability to deal with the stressor and judgements about the ultimate efficacy of these attempts -- suggest that harm is likely, the appraisal processes are, in turn, followed by various coping options.

### Coping

The study of appraisal and coping are important, both in terms of basic mechanisms by which different forms of coping operate and in the application of such mechanisms to understanding the effects of stress. Lazarus (1966) defined coping as overt and intrapsychic behaviors directed towards preventing avoiding, or controlling the source or experience of the stressor. This can be done in many ways. He suggested that these responses could be understood in terms of the two basic approaches an individual may pursue when confronted with a stressful situation (Lazarus & Launier, 1978). Direct action, commonly referred to as problem-oriented coping, features overt reactions designed to directly modify the stressful situation. Palliative coping is more accomodative; the stressful situation is accepted -- at least for the moment -- and responses are directed at managing or reducing feelings of distress. Therefore, the palliative coping style has been referred to as emotional-focused coping. This distinction is conceptually analogous to Leventhal's (1970) notion of danger and fear control. He suggests that people may directly address the source of stress (i.e., danger) to reduce or remove the posed threat, or they may focus on their emotional responses and attempt to control or reduce fear and emotional distress.

In addition to the direct and palliative coping foci, there are numerous styles and behavioral alternatives. Often, when a person is faced with a stressor, he or she can choose from several alternatives. These alternatives include fleeing, or altering the setting, seeking additional information, reappraising or denying the situation or attempting to cope in other ways. The effectiveness of these coping



strategies varies across situations and people. The person's unique experiences in similar situations are important in determining whether the circumstances he or she presently faces will be appraised as stressful, as well as influencing their coping style.

Illustrations of coping strategies are found in many different experimental and medical settings. One such example demonstrates Lazarus' dynamic coping model. Katz, Weiner, Gallagher, and Hellman (1970) have reported that many women, who after finding a suspicious breast lump and appraising it as a potential stressor, chose to select a palliative, emotional coping strategy by denying its serious health implications. However, since the initial delay in seeking medical attention was an indirect, and temporary attempt to cope with the breast lump, we would expect a change of coping strategy -- to problem focused -- as the stressor became more salient. In fact, this is what occurred. Thus, as the appraisal process involving the stressor changed, so also did the women's behavior since they now sought medical attention. Von Kugelgen (1975) has made similar observations in the case of men experiencing angina pectoris. Hackett and Cassem (1975) have reported men who during a heart attack ran up a flight of stairs or performed vigorous pushups. These men reasoned that they could not be experiencing a heart attack since the exertion did not cause them to die.

These examples demonstrate that coping strategies are dynamic, and can be altered as one's appraisal of the stressor changes. Additionally, these studies show that emotional-focused coping, that is, cognitive efforts to reduce or tolerate emotional distress, can increase the person's susceptibility to a truly life-threatening illness by

interfering with or delaying actions that could prolong one's life. Therefore, failure to expeditiously "adapt" by using the most advantageous or safest coping style, could contribute to the exacerbation of an illness.

Just as inappropriate coping can threaten the organism's well-being, so also can appropriate coping benefit the organism. The beneficial aspects of coping have been demonstrated in surgical settings. Janis (1958) interviewed patients prior to and following major surgery. He ascertained the amount of anticipatory fear the patients experienced, and based upon their interviews divided them into a high fear, moderate fear, and low fear (i.e., more angry than worried) group. Janis found that following surgery, the moderately fearful patients showed less postoperative emotional disturbance than did those patients showing extremely high or low levels of distress.

Janis explained his findings by reasoning that moderate levels of fear are optimal for facing the stressor in a realistic manner, and consequently would result in the best coping strategies. Whereas if fear is suppressed the cognitive defenses necessary for developing adequate coping would not have been developed, due possibly to the patients denying their vulnerability. The high fear group was found to have a history of psychological disorders and their post surgical problems were viewed as an extension of their previous hyperemotionality. Janis' work suggests that the manner in which a person appraises a situation (i.e., high, moderate, or low fear) mediated the coping strategy, which, in turn, affected post-surgical behavior. Thus, to account for these relationships between fear and surgical outcomes, Janis conceptualized the "work-of-worrying" -- which provided the

patients with a rehearsal mechanism to realistically cope with their stressor. The moderately fearful group used their fear, not to deny the aversive surgical stressor, but to accept the reality of the situation and to deal with it in a constructive manner.

Additional studies lend support to the notion that denial might not be the best coping strategy when faced with a stressor. One study found that children who used denial to cope with a threat showed more postoperative distress than did children who worried about things that could threaten them (Burstein & Meichenbaum, 1977). Andrew (1970) and Delong (1970), report similar results when they studied surgical patients who were also classified as deniers. When these denial subjects were provided with information pertaining to their surgery they showed poorer recovery than when they were not provided with any information.

Additional evidence for the importance of coping and appraisal is reported in a field study. Beecher (1965) reported that wounded soldiers returning from battle during WW II either denied having pain from their wounds or had so little that they did not want any medication to relieve it. These men were clear mentally, had not had any pain killers, and were not in a state of shock. Beecher noted that civilians with similar wounds obtained during surgery were observed to experience much more pain and required narcotics to reduce the pain (Beecher, 1959).

Beecher reported that the total situation and its meaning had a great positive influence on the manner in which the men reacted after experiencing their stressors. We can interpret this as meaning that the soldiers' perceived their wounds as a positive experience (relatively speaking) because they had lived through combat and would now be

reassigned. As a result of their perceptions -- and although the soldiers had tissue damage usually interpreted as painful -- the soldiers reappraised their wounds in terms of the overall situation and experienced little, if any pain, which, in turn, enhanced their recovery.

The key feature of the soldiers' and surgical patients' responses is the presumption that cognitive activities -- evaluative perception, appraisal, thoughts, and inferences -- are used by the person to interpret and guide every adaptational interchange with the environment (Beecher, 1959). An individual appraises each ongoing and changing transaction with the environment with respect to its significance for that person's well being. This appraisal includes judgements (i.e., conscious or unconscious) about present and future environmental demands and constraints as well as about the person's resources and options for managing them. The cognitive appraisal processes, as previously mentioned, are complex and symbolic, permitting people to recognize and distinguish among harm, loss, threat, and challenge, and to make numerous other subtle distinctions that give humans their complex emotional qualities.

This section has described the development of theories of stress, as well as the sources and mediators of the stress response. Conceptual examples and definitions of terms were integrated using laboratory, medical, and field settings.

#### Stress at Three Mile Island

The worst accident in U.S. history involving a nuclear reactor occurred at the Three Mile Island (TMI) nuclear generating plant in March, 1979. A number of potential sources of stress for the residents

of the TMI area have been identified. First, the accident involved the threat, or perceived threat of radiation exposure. The stressfulness of this situation was exacerbated by conflicting reports among different officials regarding how much radiation was released. The amount of radiation exposure that each of the TMI residents was exposed to, if any, is unknowable. The fact that many appraised the situation as dangerous is the key issue in their stress response. Given what we already know -- that stress results from appraisal of environmental threats as threatening or dangerous -- it follows that if people view a nearby power plant as threatening harm to them or their families, they are likely to exhibit a stress response. Initially, the TMI area residents --as did the rest of America -- attempted to find out from the media and/or officials as much information as possible about the damaged nuclear reactor. Unfortunately, often contradictory and confusing information released by the utility public information officers and other officials exaggerated rumors of new dangers. The communication breakdown and information crises which ensued may have caused more alarm than the accident itself (Presidents Commission on the Accident at Three Mile Island, 1979).

The President's Commission stated that the premature report of a pending hydrogen bubble explosion was incorrect -- "on Friday and Saturday, certain Nuclear Regulatory (NRC) officials incorrectly concluded that a hydrogen bubble in the reactor would soon contain enough oxygen to burn or explode. "The Special Inquiry Group confirms their findings by noting that fear was generated by "reports... of a possible hydrogen bubble explosion (which) turned out to have been vastly exaggerated by the NRC's disorganized response to the emergency."

These inaccurate reports, by allegedly credible sources, appear to have created uncertainty, apprehension, mistrust, and images of impending catastrophe for America in general and especially for the TMI area residents. The uncertainty surrounding the accident at TMI is typified by a statement which began the evening news (30 March, 1979) -- "the world has never seen a day quite like today ... and the biggest fear is that the worst is yet to come ..." (Stephens, 1980). That evening, TMI took 19 minutes of the regular 30 minute network nightly news broadcast. This was more time than was devoted to the Kennedy assassination in 1963, or the fall of Saigon, 1975 (Stephens, 1980).

In fact, the first two days following the accident proceeded smoothly with relatively little alarm. Flynn (1982) reports that only a few evacuated on Wednesday (28 March, 1979). It wasn't until the 30th or thereafter that people evacuated the TMI area in large numbers. This is probably due to the fact that as late as Thursday (29 March, 1979), the residents of TMI still believed the situation was under control, despite the confusion and contradictions (Flynn, 1982). Flynn reports that on Thursday (29 March, 1979) "the public generally remained calm." However, beginning on Friday (30 March, 1979) and continuing through the two week emergency period, approximately 60 percent of the persons living within 5 miles of the plant had evacuated and that approximately 45 percent of the persons living within 10 miles of the plant had also left the area (Flynn, 1979). Even though the perception of danger had reduced dramatically by the middle of the following week, the Governor's advisory concerning pregnant women and pre-school children was not lifted until April 11, two weeks after the accident. Clearly, the two week period following the accident was a period of acute stress for the TMI area residents.

Throughout the accident and the months that followed, the lives of the TMI area residents appear to have been characterized by an aura of uncertainty and stress (Bromet, 1980a, 1980b, Flynn, 1979; Flynn & Chalmers, 1979; Houts, Miller, Tokuhata, & Ham, 1980). For example, an extensive telephone survey was conducted, using random digit dialing over 366,000 subjects were interviewed. Communities in which the respondents resided were divided into geographic areas -- six categories for distance (0-5 miles, 5-10 miles, 10-15 miles, 15-25 miles, 25-40 miles, and over 40 miles) and four categories for direction (north, east, west, south) (Flynn, 1979). Flynn reports that approximately 60% of the population or about 144,000 people evacuated their homes. Flynn & Chalmers (1979) report that certain groups were more likely to have evacuated than others during the two-week emergency period, such as pregnant women and families with young children, as opposed to the plant workers who appeared to be less affected. Bromet (1980b) has reported evidence of heightened depression and anxiety among young mothers living within the TMI area, while other researchers have reported increased demoralization (Dohrenwend, Dohrenwend, Kasl, and Warheit, 1979).

Additional symptoms of physical disturbance such as headaches and gastrointestinal disturbances were reported more frequently by residents in close proximity to the plant than by those living further away (Flynn, 1979; Houts, 1980, and other authors). This heightened symptom reporting was confirmed by a local physician who also observed an increase in blood pressure following the accident (Behavioral Medicine, 1979). Additional evidence of stress among area residents comes from other behaviors such as increased use of tobacco, alcohol, tranquilizers and sedatives among the nearby residents. (Houts, et al., 1980).

Much literature has been published on adaptation to short-term stress, and the aftereffects of such stress (Cohen, 1980; Glass & Singer, 1972). This literature suggests that although concentration deficits and behavioral impairments can result after an uncontrollable acute stressor (s) (i.e., noise, noise & light) has been removed from one's environment, these deficits do not persist (Cohen, 1980; Collins, Baum, & Singer, 1983; Collins, Baum, & Singer, 1984; Glass & Singer, 1972). Conversely, chronic stress, even if low in magnitude, appears to cause excessive strain on organ systems, personal adjustment, and contributes to a wider range of physical, social, and mental problems (Baum & Valins, 1977; Cohen, Glass & Singer, 1973; Elliot & Buell, 1979; Selye & Heuser, 1956).

#### Chronic Stress at Three Mile Island

Some TMI area residents are concerned about their physical and emotional health as a result of believing that they were exposed to radiation from the damaged nuclear reactor (Baum, Schaeffer, Lake Fleming, & Collins, 1984). Whether or not the TMI area residents were actually exposed to radiation is not the real issue -- rather the uncertainty of thinking that they might be susceptible to future radiation-linked disease is a current concern in their lives (Baum, et al., 1984). Given what we already know about threat appraisal and stress responding, we can draw upon the risk perception work which suggests that radiation/nuclear facilities are seen as more dangerous by society than by knowledgeable experts. Slovic (1979) says that despite the fact that the probable effects of the accident are small, "normal modes of thought, coupled with the special qualities of nuclear hazards that make them more memorable and imaginable ... (and) blur the distinction between the possible and the probable."



The majority of the studies conducted in the immediate weeks and months following the TMI accident relied heavily, on self-report measures to determine the perceptions of the TMI residents. When one uses self-report measures exclusively, a large number of people can be sampled in a relatively short period of time, since no behavior or physiological measures are recorded. Whether a researcher chooses to use only self-report measures or opts for a multi-level paradigm which includes behavioral and biochemical measures is a classic tradeoff between studying more people in less depth or fewer people in greater depth.

Baum and his research group have used this multi-level methodology to measure and detect chronic elevated stress levels among the TMI area residents (i.e., those living within 5-miles of the damaged plant, the majority of whom can see the plant from their homes) as compared with control groups. In order to determine if living near a damaged nuclear power plant of any type of power generating plant is stressful, the TMI residents ( $n = 38$ ) were compared with samples of people living near an undamaged nuclear power plant (Oyster Creek, NJ,  $n = 32$ ), near a traditional coal fired power plant (Dickerson, MD,  $n = 24$ ), and in an area more than 20 miles from any power plant (Frederick, MD,  $n = 27$ ) for a total of 121 subjects. An attempt was made to sample areas of comparable socioeconomic status in order that the comparisons would reflect only differences related to TMI and the presence of power plants.

Fifteen months after the TMI accident, a number of self-report measures of psychological stress were collected. These included measures of depression, alienation, somatic complaints, and anxiety.

In addition, two behavioral measures of stress were obtained. The behavioral measures involved cognitive tasks such as finding errors on a 5-minute proofreading task, being able to determine the correct answer on an embedded figures task, or how long the subjects persisted on a pyramid puzzle. These behavioral tasks were shown to detect stress differences between TMI and the control groups. Catecholamine (i.e., epinephrine and norepinephrine) and cortisol excretion levels were measured for both the TMI residents and the control groups by analyzing their urine which was collected over a period of 15 hours. All data were obtained by visiting the subjects' homes and using interviews, questionnaires, tasks, and a 15-hour urine void procedure.

In general the results gathered from the initial interviews indicated that the TMI area residents reported more symptoms; some of these symptoms were greater in intensity; their urinary catecholamine levels reflected greater stress; and their performance on both a proofreading task and on an embedded figures task was poorer than were the control groups' (Baum, Gatchel, Fleming, Lake, 1981; Baum et al., 1984; Collins & Baum, 1981; Collins, Baum & Singer, 1983; Davidson, Baum, Collins, 1982). Furthermore, these same patterns still remain as long as two years after the accident (Baum, Schaeffer, Lake, Fleming, & Collins, 1984). Perceptions of threat from the damaged nuclear reactor and mistrust of public officials were also continually noted. The consistency and duration of the stress response by the TMI area residents was considered to be indicative of chronic stress at TMI. However, even during the height of the accident, certain TMI area residents showed greater susceptibility to stress than did others.

Several possible reasons to explain this selective susceptibility to stress at TMI have been reported by Baum and his colleagues. The relationship between stress and perceived levels of control for the residents at TMI has been identified as one potential mediator for influencing the stress response (Davidson, Baum, & Collins, 1983). Control related problems were identified by a behavioral task and questionnaires. Those residents at TMI who reported less control, performed more poorly on the behavioral tasks than did subjects at Frederick. The subjects at TMI who reported more loss of control had more stress-related symptoms and elevated levels of epinephrine and norepinephrine than did the comparison subjects at Frederick. Furthermore, a comparison within just the TMI group revealed that those individuals who reported having less control exhibited more stress-related symptoms than did those TMI subjects not experiencing as many control related problems (Davidson, Baum, & Collins, 1982). Additionally, those TMI residents who reported greater expectations for control did not differ significantly from comparison subjects on most variables; when expectations for control were relatively high, stress levels manifested by the TMI subjects were generally comparable to the comparison group. It should also be noted that the Frederick subjects, unlike the TMI sample, did not vary in symptoms of stress as a function of expectations for control (Davidson, Baum, & Collins, 1982).

Research by (Fleming, Baum, Gisriel & Gatchel, 1982) have also reported the mediating influences of social support on the stress response at TMI. The measurement of social support was measured using a six-item scale, which quantified the individuals' perceptions regarding their access to emotional support.

The TMI residents who reported low levels of social support reported more depression, anxiety, alienation, and symptoms of stress than did those subjects at TMI who reported high levels of social support or did subjects in the comparison group (Fleming, Baum, Gisriel, Gatchel, 1982). Depression was measured using the Beck Depression Inventory (Beck, 1967), while anxiety, alienation, and total number of symptoms was obtained using the Symptom Checklist-90 (Derogatis, Rickels, & Rock, 1976). TMI area residents reporting low levels of social support performed more poorly on the embedded figures task and a proofreading task (Glass & Singer, 1972) than did subjects in any other condition. Biochemical measures of epinephrine and norepinephrine were higher as a group at TMI than in the experimental control conditions, with norepinephrine at TMI increasing as the perceived level of social support decreased. This norepinephrine pattern was significantly different than that found among the control groups.

Further findings by Baum's research group (Baum, Fleming, & Singer, 1983; Collins, Baum, Singer, 1983) have reported on the mediating effects that different coping styles have on the stress responses of the TMI area residents. Since the issue of coping is central to this dissertation, it will be addressed in greater depth.

#### Coping at Three Mile Island

Coping, as has been defined previously, refers to overt and intrapsychic behavior which is directed towards preventing, avoiding or controlling the source or experience of stress (Lazarus, 1966). Lazarus (1966) suggests that coping may serve two different purposes: directly addressing a situation or problem, or a palliative, emotionally focused response to the situation.

Coping was measure by having subjects complete the Ways of Coping Inventory (WCI) (e.g., Aldwin, Folkman, Schaeffer, Coyne, & Lazarus, 1980; Folkman & Lazarus, 1980), which is a 68-item checklist reflecting different ways of coping with a problem. The problem-focused, and emotional-focused coping subscales of the WCI were used to discriminate residents who used the different coping styles. The problem-oriented subscale provides an estimate of the degree to which people directly confront a problem whereas the emotional-focused subscale measures the regulation of emotional response when faced with a problem. "I make plans of action and follow them" is an example of a question that measures a problem-oriented coping style. "I go on as if nothing has happened " represents an emotional focused coping style. Measurement of reappraisal and denial coping styles were obtained by using a 4-item denial scale, and a 5-item reappraisal scale. (1) Both of these scales were comprised of items taken primarily from the emotional management subscales.

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(1) After an examination of internal consistency was performed, it became apparent that a single item in each subscale was being endorsed by all subjects endorsing any item and was largely responsible for differences across subjects. Regardless of the number of denial items reported as relevant, if any were checked at all, one of them was "I refuse to believe what is happening." Similarly, if any reappraisal items were checked, one was always, "I concentrate on something good that may come of this." As a result, subjects were split into groups based on whether they endorsed these items, as well as by median splits. Obtained values were very similar using both techniques. The splits reported were based on whether subjects did or did not endorse these critical items. As a result, the groups reflect people who report use of denial or reappraisal and people who report no use of denial and reappraisal, based on response to the single item in each group. In order to rule out the possibility that educational level differences among TMI subjects could have exerted an influence on performance on this task, educational level was correlated with proof-reading scores. The degree of relatedness indicated by this procedure was very small ( $r = .14$ ).

The results suggested that residents reporting strong use of emotional management -- who focus on the regulation of their emotional response to the chronic stress at TMI -- exhibited less stress than did residents reporting use of a problem-oriented coping strategy. Reappraisal coping strategies were also found to be more effective in reducing stress at TMI than was denial. A possible reason for these findings may be that the chronic situation at TMI allows the individual to create less threatening ways of viewing a stressor when reappraisal or emotional-focused coping is used. In fact, TMI residents using emotional types of coping showed less stress and were comparable to the control subjects. Control subjects were instructed to answer conceptually analagous questions pertaining to problems they encountered as a result of living near "their" power generating plant.

Conversely, those TMI residents who were highly problem oriented or who chose a denial focused coping strategy reported more symptoms and depression than did TMI residents reporting less use of these strategies. Denial was also associated with poorer performance on the behavioral tasks (Collins, Baum, & Singer, 1983). These findings are understandable when one considers the difficulty of using either untenable coping style given the complexity and chronicity of the problem at TMI. Thus, Collins et al. (1983) conclude that conditions that are long term or sufficiently salient to make them difficult to ignore are expected to render denial less effective and frustration associated with direct manipulation of an intractible situation made problem-solving less useful than were emotional-focused or reappraisal coping styles. Additional support for increased stress associated with

the use of denial as a coping strategy comes from Mullin and Suls (1982). These authors suggest that when one's attention is continually being redirected back to a stressor or when that stressor is prolonged, the use of a rejection or denial type of coping style would be relatively ineffective. Thus, when an emotional coping style was used by the TMI residents, less stress was reported among the self-report and behavioral measures than when a problem focused, denial, or no self-blame coping style was used.

Regressions of coping focus and style on catecholamine measures of stress suggest that none of the coping styles accounted for a significant portion of the variance associated with urinary epinephrine. Use of reappraisal, however, was a significant predictor of norepinephrine levels whereas, denial did not influence the level of norepinephrine. Comparing the TMI group and the control groups, it was found that when TMI residents reported reappraisal as a coping style, their levels of norepinephrine were comparable to those levels found within the control group. Thus, coping style did not affect the arousal level -- it being higher overall at TMI -- but enhanced the psychological and behavioral abilities to deal with stress, providing the coping style used was emotionally focused. Control subjects did not show alterations in stress levels as a function of coping style.

#### Control-Related Explanations

A possible explanation of the selective susceptibility to stress and the choice of a coping strategy is the degree to which the coping strategies reinforce the resident's sense of control. One goal of coping may be to increase one's sense of control, and strategies that are perceived as maximizing gain of control may be preferred and be more

effective (Baum, Fleming & Singer, 1983; Davidson, Baum & Collins, 1983). This interpretation is supported by data on the TMI subjects' perception of control. Those residents who reported more use of emotional coping perceived greater confidence and more control in regulating their contact with people, reported fewer feelings of helplessness, had a more positive outlook (in general) on attempting to control their environmental interactions, and valued their choices more than did other TMI subjects. Conversely, problem-focused coping was associated with feelings of less control.

Interestingly, attributions of responsibility for victimization resulting from the TMI accident provided additional evidence of the importance of perceived control in effective coping. One method that could be used by the TMI area residents to enhance their sense of control would be to assign blame for their problems to themselves. Certainly, self-blame for the TMI accident would be rare, but if it was couched in the terms of the problems they experienced after the accident -- self-blame attribution should be more likely. It follows that, if the TMI situation has chronically threatened one's sense of control, and if using self-blame as a coping style increases one's sense of control (over their problems), then the TMI area residents who attribute some blame to themselves for their problems should report a greater sense of control, than those person's not assuming any responsibility. Consequently, greater feelings of control should, in turn, help to modify and reduce the stress response exhibited by the TMI area residents. In fact, this finding was recently reported by Baum and



his colleagues (Baum, Fleming, & Singer, 1983). Furthermore, they found that the TMI area residents who engaged in at least some self-blame responded comparably to the control subjects. However, at the comparison sites, self-blame did not affect the subjects' responses. In fact, self-blame can be thought of as a form of emotional reappraisal, which results in greater feelings of control.

The findings of Baum's research group is conceptually supported by Bulman and Wortman (1977) who reported that some assumption of personal responsibility is associated with a reduction of stress-related problems. Bulman and Wortman found that paraplegics (paralyzed from the waist down) and quadraplegics (paralyzed from the neck down) who were involved in traumatic accidents (i.e., falls, shootings, & auto accidents) viewed their present situation in a more positive manner if they attributed responsibility for their handicap to themselves than if they blamed others for their handicap. Similarly, Langer (1975) found that when people could associate their involvement to an outcome, the subjects viewed their situation in a more positive manner. This perception occurred even though the outcome was pure chance (i.e., as in attempting to select a lottery ticket). Interestingly, Langer's (1975) subjects bolstered their self-esteem by attributing responsibility for their successes to themselves but shifted the blame for their failure to chance. Thus, among the TMI area residents, those who coped by using an emotionally-oriented coping style such as self-blame, could be expected to have fewer symptoms of stress than those TMI residents using a problem-focused coping strategy.

A great deal of overlap was shown between the self-blame and emotionally-focused coping styles. Of the self-blammers at TMI, 70% also

used emotionally-focused coping strategies. The similarity of the self-blame and emotionally-focused coping styles was also evident by the TMI area residents reporting both fewer symptoms and greater perceptions of control over their personal lives. The co-occurrence of these two control-oriented coping styles lends additional support to the possibility that they are linked to enhancing one's perception of control (Baum et al., 1983). Thus, if the subjects are given a task over which they have no actual control in determining the outcome (i.e., success or failure on a task) will the TMI subjects who use a control-oriented coping style be more likely to strive to create the perception of control than the TMI subjects using a noncontrol-oriented coping style?

Previous research by Wortman (1975) and Langer (1975) on control-related behaviors reported that some of their subjects spontaneously exhibited different types of behaviors during their experiments. These control-related behaviors included reaching in a certain way for a desirable marble or the method of rolling dice (either by hand or by using a dice cup). In Langer's study, while subjects were rolling dice an experimenter observed that some subjects spontaneously used their hands while others spontaneously chose to use the dice cup. It was suggested that those rolling the dice by hand were trying to exert control more so than did those using the dice cup and that future research was needed to confirm or refute this interpretation.

These behavioral actions were interpreted by these authors as suggesting that the subjects are attempting to favorably manipulate a chance situation through their behavioral involvement with the task. The authors further indicated that the behaviors of their subjects

suggested that they were trying to create for themselves a greater perception of control. It is possible that the present study would support this interpretation. Previous research by Baum's research group has that under stress persistence differences associated with a pyramid task were detected between TMI and a control group. Consequently, persistence was also used in the present study to indicate differences in stress responding between residential locations. Specifically, the number of trials (i.e., persistence) that the subjects attempted on the chance tasks was used as the persistence measure.

## Hypotheses and Methods

### Hypotheses

As has already been noted High-Control-Oriented copers (HCO) are those who appear to seek out or to create the perception of control over their environment in order to mediate their stress responses. There is evidence that people overestimate the amount of control they have, especially when given the opportunity to become involved in a task. For example, Langer (1975) has shown that when people could link their own actions to an outcome -- even though that outcome was determined purely by chance (i.e., a lottery), subjects bolstered their self-esteem by overestimating the amount of control they had for their successes and attributing blame for their failures to chance. A similar effect was found by Wortman, 1975. These authors also report that their subjects spontaneously used control-related behaviors (i.e., reaching in a certain way for a desirable object or not using the dice cup and using their hands to roll the dice) in their attempts to favorably manipulate a chance situation. The present research will consider a modification of this work. It will manipulate subjects' behavioral involvement (high vs low) on chance tasks to determine if HCO-copers will persist longer on these tasks than will LCO-copers and if more TMI residents would roll the dice by hand (i.e., in an attempt to regain control) than would the Frederick residents. Furthermore, coping styles (i.e., High-Control-Oriented and Low-Control-Oriented) were hypothesized to influence the method of dice rolling (i.e., hand vs dice cup).

It has already been documented that chronic stress exists among the TMI area residents. Many of the residents at TMI still remain uncertain about their future health and well-being and face the possibility that they were exposed to radiation from a damaged nuclear reactor. Furthermore, the situation at TMI has still not been resolved: there are several radioactive areas around the damaged TMI-2 nuclear reactor. Yet despite the common experiences of the TMI area residents (i.e., all experiencing the initial accident and living within 5 miles of the damaged nuclear reactor) there exists among this group a selective susceptibility to stress, which appears to be associated with their style of coping.

The present research considered the relationship between two coping styles: High-Control-Oriented (HCO) and Low-Control-Oriented (LCO) coping and the persistence differences that result from two levels of physical involvement (high vs low) on chance tasks, where the subject's inputs do not contribute to the task solutions. The subject attempted to predict the two-digit numbers that would next appear on a Hewlett-Packard (HP-41CV) calculator programmed to be a random number generator and that would appear on a pair of dice.

The study also addressed the tendency for differences associated with the method of dice rolling (i.e., dice cup vs hand). to exist between locations (i.e., TMI & Frederick). Previous research by Wortman, (1975) and Langer, (1975) suggests that the overt motor behaviors of subjects (i.e., dice rolling by hand vs a dice cup or attempting to reach for an unseen desirable marble in a certain way) reflects their attempts to gain control over the chance situations and may in turn, increase actual feelings of control. Specifically the TMI

residents were expected to choose to use their hands to roll the dice more than the Frederick residents. This difference could suggest that the TMI residents are attempting to exert more control over their environment than the Fredrick residents. Given this paradigm the following hypotheses are to be tested:

1. Subjects' persistence will vary with level of involvement; subjects in the low involving conditions of the chance tasks will show significantly less persistence than when they are highly involved.
2. The stressful experience of living near TMI would influence persistence, such that the TMI residents, would exhibit significantly less persistence on the chance tasks than will the subjects of a control group.
3. The subjects who have used High-Control-Oriented coping styles (i.e., self-blame and emotional-focused coping) in the past will show greater persistence on the chance tasks than will those subjects using a Low-Control-Oriented coping style.
4. The chosen method of dice rolling (i.e., hand or dice cup) will be significantly different between groups, with more of the TMI subjects choosing to use their hand instead of the dice cup than will be noted among the control subjects (Frederick residents).
5. The High-Control-Oriented TMI subjects who chose to use their hand to roll the dice will persist less when noncontingencies were experienced than the TMI Low-Control-Oriented subjects.

### Methods

A total of 56 subjects participated in this study. Of these, 31 were sampled from neighborhoods within 5 miles of Three Mile Island and 25 were sampled from demographically similar areas in Frederick, Maryland. The latter group, living more than 80 miles from TMI and 15 miles from any power plant, was used as a comparison group. The subjects used in this study were part of an ongoing longitudinal study which has been conducted by Baum and his research group since 1980. The subjects were originally selected by a quasi-random procedure. Residential streets were sampled and subjects were recruited from every third house on each sampled street. Response rates averaged 75%. Based upon previous studies coping data was available on 34 subjects, 19 from TMI and 15 from Frederick, Maryland.

### Independent Variables

The independent variables (IV's) for this study consisted of: (a) two coping style clusters: (i.e., High-Control-Oriented (HCO) coping and Low-Control-Oriented (LCO) coping); (b) the level of physical involvement (high and low) during two chance tasks that always resulted in failure. Location of residence (TMI or Frederick, MD) was varied as well. High-Control-Oriented coping (HCO) (i.e., emotional and self-blame) is coping that appears to be directed towards creating or maintaining a sense of control over a stressful situation. Subjects were classified as High-Control-Oriented Copers (HCO) or Low-Control-Oriented Copers (LCO) in the following manner. High-Control-Oriented Copers were operationalized as those subjects who reported previous use of self-blame and were above the median on the emotional subscale of the Lazarus Ways of Coping scale. Those subjects who previously used coping

styles that do not suggest attempts to enhance control -- no use of self-blame or below the median on the emotional subscale of the Lazarus Ways of Coping scale -- were classified as Low-Control-Oriented Copers.<sup>(5)</sup> It should be noted that not all subjects were classifiable as High- or Low-Control-Oriented-Copers since only those subjects who satisfied either of these criteria were categorized as either High- or Low-Control-Oriented copers. Consequently, some subjects could not be classified and were not used in those analyses which required the control-oriented coping style distinction.

The subjects' level of involvement (high vs. low) on two chance tasks was manipulated by having the subjects predict the next 2-digit number they thought would appear on a pair of dice and on a random number generator. In the high involvement conditions the subjects told the experimenter their predicted numbers, then they physically rolled the dice or pushed the computer key that began the random number generator. In the low involvement condition, the subjects merely told

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(5) The Lazarus Ways of Coping Inventory (WCI) (Folkman & Lazarus, 1980) is a 68-item checklist that reflects a wide variety of different ways of coping with problems. The WCI has at least 2 identifiable subscales. These two subscales reflect problem-and emotion-focused coping. The TMI residents who primarily used the emotional focused coping style reported fewer symptoms of stress. The residents at TMI (and at a control group) were asked to indicate to what extent they blamed themselves for their problems. The TMI subjects who assumed some responsibility for their predicaments also resulted in fewer stress symptoms and an increased perception of control.

This is highlighted by regression analyses conducted to assess the relative contribution of self-blame and emotion-focused coping to ratings of perceived control. When all subjects were considered, the relationships among these variables were modest at best: Total  $r^2$  values for self-blame and emotional coping were less than .10 for most control items. However,<sup>2</sup> when only TMI subjects were considered, self-blame alone yielded an  $r^2$  of .25 for feelings of helplessness, and .17 for general perceptions of control.



the experimenter their predicted numbers, then the experimenter rolled the dice or pushed the computer key that started the random number generator.

#### Dependent Variables

The dependent variables for this study are the number of trials (i.e., persistence) subjects undertook on the random number generator task and with the dice task, as well as the method (i.e., dice cup or hand) of dice rolling. In addition, answers to certain questions were obtained using 7-point scales during and after the task presentations (Appendix A).

#### Procedures

All subjects were interviewed in their homes. During the interview the experimenter explained to the subject that they would be working on two tasks which were part of a larger test battery. These tasks would require some concentration by the subjects and were being given for the first time to a subsample of people to ensure that there would be no carry-over effects such as fatigue etc., that may in some way confound the data. Subjects were additionally informed that the data collected from our session would be used for a Ph.D. dissertation and that the subjects should answer all questions in an honest straight forward manner -- just like they have done in past tasks that were administered to them.

Subjects were informed that they would be performing two tasks. Both tasks were described as being very similar to playing a lottery. The subjects were told that they would be asked to select a two-digit number that they thought would next appear when a pair of dice were rolled. One dice was white and the other dice was brown. In all

cases the white dice represented the first digit (of the two digit number) and the brown dice represented the second digit number. Subjects were informed that this task would be performed at least four times with the dice being rolled by the experimenter (if the subject was in the low involvement condition) or by the subject if the subject was in the high involvement condition. Subjects were only told who would be rolling the dice (i.e., the experimenter or themselves). Additionally, it was explained to the subjects that after the first four trials they would be given a brief questionnaire to fill out and that if they wished they could continue using the dice for some additional predictions.

The next task was explained to the subjects as being very similar to the dice task, the only difference being that this time a sophisticated calculator (i.e., a Hewlett-Packard-41CV programmed with a random number generator program) would generate the numbers instead of the dice.<sup>(2)</sup> However, this time the subject was in the other involvement condition, such that if the subject was highly involved in the dice task then he/she would be in the low involvement condition during the calculator task, etc. Consequently, the subjects were told that the only difference between the calculator task and the dice task was that this time the subject (would/or would not) be participating in initiating the task. The experimenter reiterated to the subject that he/she would still be predicting the 2-digit number that they thought would next appear -- just as they did on the last task. Also, just like on the previous task subjects were given a questionnaire after

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(2) The order of task presentation, as well as level of involvement was randomized throughout the study.

the fourth presentation and could continue with the task as long as they wished -- or until the experimenter had to leave for the next appointment. Subjects were finally informed that if they did well enough, that they would win a felt tipped pen which the experimenter showed to the subject and then placed out of sight.

Subjects were always informed that their predictions were incorrect -- even if their answer was correct to ensure that all subjects experienced failure and future uncertainty on these tasks. This was accomplished by having the subjects roll the dice into a shoe box which was placed on its side and faced away from the subject. One of the sides (i.e., an end) of the shoe box had been removed to allow the dice to be thrown into it with ease and still prevent the subjects from seeing the dice. Subjects were prevented from seeing which numbers appeared on the calculator task by turning the detachable remote printer (e.g. attached to the calculator by an 18 inch umbilical wire) away from the subject towards the experimenter. A piece of electrician's tape was placed over the calculator display window to prevent the subject from seeing the numbers.

The experimenter surreptitiously recorded not only the number of trials the subject persisted on each task but also recorded whether the subject spontaneously rolled the dice by using their hand or if they used the dice cup. It should be noted that after the experimenter explained the procedures of the dice task to the subject he placed the dice, one die width away from the dice cup so that the subject would determine the method of dice rolling.

At the end of the study after thanking the subject for his/her time the experimenter gave the subject the felt tipped pen as a token of the experimenter's appreciation. Subjects were debriefed.

## Results

Analyses were conducted to investigate the hypotheses that subjects performing tasks in which they were highly involved would persist longer than when they were not highly involved; that the method of dice rolling would be significantly different between locations with more TMI subjects using their hands to roll the dice than would occur at Frederick; that the stressful experience of living near TMI would influence persistence, such that the residents of TMI would persist less on the chance tasks than would the residents of Frederick; and that people using a High-Control-Oriented coping style would persist longer on the chance tasks, than would individuals using a Low-Control-Oriented coping strategy. Level of involvement, place of residence, and coping style were evaluated as independent factors, while the measures of persistence on the chance tasks were used as the primary dependent variables.

The check on the manipulation of involvement is presented first, followed by the persistence differences associated with the manipulated levels of participation (i.e., high and low involvement), residence (TMI and Frederick), and coping styles (HCO and LCO). Persistence differences between residential locations associated with the manner in which the dice were thrown are then presented. The analyses which are presented are collapsed across gender since no sex differences were found. The values reported are means with higher values representing more trials on the chance tasks.

### Manipulation Check

In order to ensure that the manipulations of high and low involvement were effective, a manipulation check was embedded in a post-task questionnaire. The question asked subjects to indicate which of the two chance tasks (i.e., dice or random number generator task) they felt more involved with during the experiment. For each subject, one task was highly involving while the other was a low involvement task. In all cases the answers of the subjects coincided with the intended manipulations of high and low involvement.

### Persistence

Analyses were conducted to investigate the primary hypotheses about how persistence on the chance tasks was influenced by level of involvement, coping style, and location of residence. In general, subjects were expected to persist longer when highly involved in the chance tasks than when in the low involvement condition. Residents of TMI were expected to persist less than were residents of Frederick and HCO-copers were expected to persist more than LCO-copers.

Level of Involvement, Coping Style and Residence A three-way, 2 by 2 by 2 analysis of variance (Residence x Involvement x Coping Style) was conducted on the number of trials that the subjects spent working on the chance tasks. Since each subject participated in both a high and a low involvement condition the persistence measures obtained from these two involvement conditions were treated as repeated measures. This analysis revealed a main effect for involvement  $F(1, 30) = 33.75$ ,  $p < .001$  and a marginal effect for residence  $F(1, 30) = 3.37$ ,  $p < .076$  (see Appendix A, Table s-1, page 66). The summary of means is presented

in Table 1, page 43. This suggests that the involvement manipulations had the hypothesized effect on influencing the persistence of the subjects.

Table 1  
Persistence by Residence, Coping, and Involvement

TMI ( <u>N</u> = 17 )		FRED ( <u>N</u> = 17 )			
	HCO ( <u>n</u> = 9 )	LCO ( <u>n</u> = 8 )	HCO ( <u>n</u> = 10 )	LCO ( <u>n</u> = 7 )	Mean
High	8.22	8.00	11.75	9.43	9.24
Involvement					
Low	5.11	5.60	8.25	6.86	6.35
TMI <u>M</u> = 6.73		FRED <u>M</u> = 9.13			

Since this 2x2x2 analysis of variance included some subjects who persisted beyond the required four trials and some who did not persist beyond the required 4 trials, another 2x2x2 analysis of variance was performed. Prior to doing this 2x2x2 analysis of variance 3 Chi-square analyses were performed on persistence greater than four trials (i.e., persistence by residence, persistence by involvement, and persistence by coping style) in order to ensure that an equivalent number of subjects persisted in each condition. All the chi-square analyses were nonsignificant suggesting that persistence rates across conditions were comparable. This time the 2x2x2 analysis of variance examined only the scores of those subjects who actually persisted beyond the required four trials. Consequently, this analysis more accurately measures the hypothesized persistence differences, since it includes only those who, in fact, persisted. The summary of means is presented in Table 2, page 45. This time the analysis revealed a significant effect for involvement  $F(1, 23) = 47.09$ ,  $p < .001$  as well as for place of residence  $F(1, 23) = 5.24$ ,  $p < .03$  (see Appendix A, Table s-2, page 67). Subjects in the high involvement condition persisted longer than subjects in the low involvement condition and the Frederick residents persisted longer than did the TMI residents (see Table 2, page 45). Post-hoc analyses (Tukey's Multiple-Comparison Tests) revealed that significant ( $p < .05$ ) residential differences were noted on persistence between the levels of involvement, but only on the High-Control-Oriented coping dimension. Similarly, post-hoc analyses also showed that significant ( $p < .05$ ) differences were noted on persistence associated with the level of involvement within residences, but again this difference was only noted on the High-Control-Oriented coping dimension.



Table 2  
 Persistence by Residence, Coping, and Involvement  
 (Trials Greater Than Four)

		TMI		FRED		
		( <u>N</u> = 15 )		( <u>N</u> = 12 )		
		HCO	LCO	HCO	LCO	Mean
		( <u>n</u> = 8 )	( <u>n</u> = 7 )	( <u>n</u> = 6 )	( <u>n</u> = 6 )	
Involvement	High	8.75	9.71	14.33	10.33	10.59
	Low	5.25	6.29	9.67	7.33	6.96
		TMI <u>M</u> = 7.47		FRED <u>M</u> = 10.42		

### Control-Related Behavioral Differences Between Residences

As was previously mentioned in the methods section, two methods of dice rolling were possible: either rolling the dice by hand or by using the dice cup. One of the hypotheses to be tested was that more subjects at TMI would spontaneously choose to use their hands to roll the dice than would be noted among the control subjects. A Chi-square analysis was performed on the number of subjects choosing to use the dice cup to roll the dice versus how often the choice was to roll the dice by hand. As can be seen from Table 3 more people at TMI used their hands to roll the dice than at Frederick. In fact, more of the Frederick residents rolled the dice with their hands.

Table 3  
Chi-Square Analysis Between Locations  
on Method of Dice Rolling

	Dice Cup	Hand
TMI	09	22
FRED	25	00

$$\chi^2 (1, N = 56) = 29.22, p < .001$$

### Persistence at TMI by Coping, Involvement, and Method of Dice Rolling.

To further investigate the relationship of persistence with method of dice rolling, a 3-way analysis of variance examined persistence within the TMI sample on the dice task using coping styles, levels of involvement and method of dice rolling as the independent variables. A similar 3-way analysis of variance could not be performed

between residential groups, or within the Frederick sample, because none of the Frederick subjects chose to use the hand method of dice rolling. This analysis was performed to see if subjects in the high involvement condition would persist longer than did subjects in the low involvement condition as a function of coping styles and the subject's method of dice rolling. The 3-way analysis of variance revealed a significant main effect for level of involvement, with subjects persisting longer when in the high involvement condition ( $\bar{M} = 8.22$ ) than when in the low involvement condition ( $\bar{M} = 4.90$ ),  $F(1, 11) = 5.58$   $p < .038$ . An interaction between, (see Table s-3, page 68) coping styles and method of dice rolling was also noted  $F(1, 11) = 5.45$ ,  $p < .04$ . This interaction revealed that, High-Control-Oriented copers who chose to roll the dice with their hands exhibited less persistence than did Low-Control-Oriented copers who also chose this method of dice rolling but, when the dice cup was used the subjects who were High-Control-Oriented persisted more than did the Low-Control-Oriented Copers. The summary of means is presented in Table 4, page 49. This finding suggests that the hypothesized persistence differences existed only when the dice cup was used but not when the dice were rolled by hand.

The 3-way analysis of variance revealed a significant main effect for level of involvement, with subjects persisting longer when in the high involvement condition ( $\bar{M} = 8.22$ ) than when in the low involvement condition ( $\bar{M} = 4.90$ ),  $F(1, 11) = 5.58$   $p < .038$ . An interaction between coping styles and method of dice rolling showed that HCO subjects who chose to roll the dice with their hands exhibited less persistence than did LCO-hand rollers, or HCO-dice cup rollers (see Table 4, page 49). Moreover, LCO-dice cup rollers persisted less than HCO-dice cup rollers, which suggests that coping styles (HCO vs. LCO) did have an effect on the subject's persistence.

Only HCO-copers at TMI who used the dice cup showed more persistence than others. Furthermore, the dice cup-HCO-copers were the only ones showing high persistence. Despite the interaction between coping styles and method of dice rolling, HCO-copers still persisted more ( $\bar{M} = 6.75$ ) overall than LCO-copers ( $\bar{M} = 5.69$ ). The 3-way interaction was only marginally significant  $F(1, 11) = 4.62$ ,  $p < .06$ .

Table 4  
Persistence by Coping and Method of Dice Rolling

	Method		Mean
	Hand	Dice Cup	
HCO	5.17	8.33	6.22
	( n = 16)	( <u>n</u> = 3)	
Coping			
LCO	7.38	4.00	6.70
	( <u>n</u> = 8)	( <u>n</u> = 2)	
	6.43	6.60	

## Discussion

The present research was conducted to provide information about persistence differences between a chronically stressed population -- TMI, and a nonstressed control group -- Frederick, Maryland. More specifically, it considered how level of involvement and coping styles, affected performance on two chance tasks: a dice task and a computer generated number task. The hypotheses of this field research were that the TMI residents would exhibit significantly less persistence on the chance tasks than would a control group. Furthermore, it was hypothesized that the subjects when less involved in the tasks would show significantly less persistence than would subjects in the highly involving conditions. The method selected to roll the dice (i.e, hand or cup) was hypothesized to be significantly different between groups, with more of the TMI subjects rolling the dice by hand than would be noted among the Frederick residents. Subjects with a High-Control-Orientation were predicted to persist longer than those subjects with a low control orientation.

The findings suggest a number of conclusions. First, living near TMI appears to have affected the behavior of these residents. This was demonstrated by the behaviors of the Three Mile Island residents who exhibited less persistence on the chance tasks than did comparison subjects. The choice of method of dice rolling used by the residents of TMI was significantly different than that used by the subjects at the control group. These responses appear to be related to the TMI residents experiences with chronic stress and other influences in their environment.

Interestingly the manipulated involvement conditions effected subjects from both residential locations in a similar manner. Specifically, when noncontingencies were experienced on the chance tasks, the subjects gave up sooner in the low involvement condition than when highly involved on the tasks. An important point to be made here is that in both levels of involvement the subjects always experienced noncontingencies (i.e., failure to correctly influence or predict the chance task outcome), yet their persistence was influenced by involvement and location of residence. Overall, the TMI residents persisted on significantly fewer trials than did the residents of the control group.

A potential explanation for the persistence differences associated with the involvement conditions can be found in the work of Langer (1975) and Wortman (1975). Langer (1975) and Wortman (1975) have shown that people overestimate the amount of control they have in situations in which outcomes are determined by chance. They found that when subjects were given the opportunity to become involved in a chance task and could link their involvement to an outcome even though the out-come was independent of their involvement, they perceived themselves as having more control over the outcome and showed more persistence on their tasks. Similarly, the subjects in this study were given the opportunity to become involved with chance tasks.

Persistence associated with the method of dice rolling (i.e. dice cup or hand) was expected to vary as a function of involvement, method of dice rolling, and coping style. Regardless of the method of dice rolling greater persistence was found in the high involvement condition than in the low involvement condition. The relationship between the method of dice rolling and coping styles was hypothesized

to be more complex. First, because of the chronic stress of living in an environment you can not control we hypothesized that there would be more hand dice rollers at TMI than at Frederick. This hypothesis assumes that people who use their hand would be attempting to gain more control. The data confirm this hypothesis. However, it was hypothesized that for High-Control-Oriented copers those who attempted to gain further control by using their hand would persist less than those using the dice cup. Their attempt to gain control involved terminating a nonproductive situation. Second, because of chronic exposure to the uncontrollable setting at TMI the persistence on the dice task was hypothesized to vary as a function of coping style, with High-Control-Oriented copers generally persisting longer than Low-Control-Oriented copers. However, this persistence difference would be influenced by how sensitized the people at TMI were to their being continually exposed to the uncontrollable setting at TMI. Thus, as a function of the TMI residents using a particular coping style (i.e., High-Control-Oriented) they may have become more motivated to control situations at the outset, but when control was not immediately forthcoming they may have jumped to the conclusion that this is another uncontrollable situation and gave up more readily -- since they have been sensitized (because of their residence) to noncontingencies. Baum and Gatchel (1981) used this description to explain the performance behaviors of dormitory residents. The same description (the change from reactance to withdrawal) could explain the persistence associated with those TMI residents who chose to roll the dice by hand and were High-Control-Oriented copers. It could be that the choice (whether conscious or sub-



conscious) to roll the dice by hand predicts who will change from a reactance (i.e., persistence) approach to a withdrawal (i.e., giving up) approach for people who have been chronically exposed to a noncontingent environment like TMI. The reactance-withdrawal explanation is consistent with a diagnostic process similar to the hypothesis testing notion proposed by Schulz and Hamsa (unpublished manuscript) and Wortman & Dintzer (1978). For people who find themselves in a problem situation that they can not do anything about giving up quickly on a noncontingent task could be the most adaptive response.

Consistent with the previous explanation it follows that the Low-Control-Oriented copers would not be as sensitized by noncontingencies, since their coping style reflects less need for control and consequently they would not demonstrate the reactance-withdrawal response as soon as the HCO-hand copers. Additionally it seems that among the Low-Control-Oriented Copers there were 2 subgroups: those who had a very low need to exert control used the dice cup, and those with a higher need for control used the hand method of dice rolling. Thus those Low-Control-Oriented copers who rolled the dice by hand should persist longer than those LCO-copers using the dice cup since rolling the dice by hand suggests more of a tendency to exert control. Furthermore, it appears that the LCO-hand rollers appear not to be as sensitized as the HCO-hand rollers and persisted longer, since it takes them longer to determine that the task is uncontrollable.

An alternative interpretation is that the persistence differences could be due to some type of acquiescence on the subjects part in trying

to please the experimenter. However, the subjects anecdotal comments would seem to discount this explanation.

Implications for risk-taking behavior, financial gambling, and taking chances when operating a vehicle are all examples of people perceiving more control over their situation than actually exists. An example which is germane to this study pertains to gambling behaviors. Some people persist in these activities despite knowing that statistically they are likely to lose more than they will win. Interestingly, people play some games of chance more than they play others. In many gambling casinos, it is readily apparent that the slot machines are associated with more activity than occurs at the roulette table. This phenomenon may be explained by the fact that slot machines are conceptually similar to the high involvement condition in this field experiment. That is, in the present research people chose to continue (i.e., persist) with the task and initiated the action -- whether physically throwing the dice or physically pushing a key on the computer's keyboard, in hopes of winning a prize. A conceptually similar example would be that people playing slot machines also choose to continue playing, are highly involved in their chance situation -- physically inserting their money, and physically pulling the handle.

Conversely, roulette is similar to the low involvement condition of this field experiment. That is, the subjects not highly involved merely stated their predicted numbers; the experimenter then initiated the action (i.e., rolling the dice or pushing the start button on the computer's keyboard). Similarly, gamblers at a roulette table simply make their numerical selection and a casino employee, not the gambler, initiates the action by spinning the roulette wheel.

Other nontrivial behaviors linked to people feeling they have more control over a chance situation include anecdotal reports of fighter pilots shot down after making a second pass on a target. At least two factors are worth mentioning here. First, flying a fighter is a very involving experience that leads the aircrew member (s) to have a heightened sense of control. This perception would be further heightened by the fact that they had already made one successful pass on the target (i.e., if we did it once and survived we can probably do it again). Consequently, it should come as no surprise that many fighter pilots became prisoners of war (POWs) because they made a second pass at the target -- despite discretionary warnings to the contrary (Personal communication with ex-POWs). Their behaviors may be difficult for lay people to understand, or even, in retrospect, for the aircrews themselves to adequately explain, but are certainly comprehensible in the theoretical terms of the present research.

Another explanation for lower persistence associated with the Three Mile Island residents can be found in the literature pertaining to learned helplessness (Seligman, 1975) and aftereffects (Glass & Singer, 1972). This literature has shown lower persistence and a decreased tolerance for frustration when the perception of control over the stressor is perceived to be nonexistent. It is similarly possible that the TMI subjects may be experiencing some form of helplessness behavior which can be influenced by altering their level of involvement associated with the stressor. Previous research at Three Mile Island (Davidson, Baum, & Collins, 1982) has shown that helplessness and reported levels of stress are associated with perceptions of control.

This finding was reflected on self-report, behavioral, and psycho-endocrine measures. Implications for clinical research regarding survivors of man-made cataclysmic events or on individuals who perceive themselves as being victimized by some similar accident could benefit from the findings of this study. Also, since this research studied the psychological effects of chronic stress, other persons experiencing chronic stress might benefit from our findings as well. Future research may demonstrate similar findings among individuals also perceiving themselves as experiencing chronic stress, such as people with post traumatic stress disorders (PTSD).

The data suggest that the differences in persistence between locations and among the TMI residents could be explained in terms of sensitization or other motivational impairments associated with environmental experiences. The findings of the present research are consistent with previous research on TMI that has suggested a relationship between chronic stress, loss of control, and behavioral decrements on task performance (Davidson, Baum, & Collins, 1982).

The TMI residents as a group chose to use a different method of rolling the dice than did the residents of the control group. The overwhelming majority of the TMI residents used their hands to throw the dice whereas, no one at Frederick used their hands to throw the dice, instead the Frederick residents chose to use the dice cup. This preference could possibly be due to the stress and noncontingencies associated with the nuclear accident, which could have influenced the TMI residents perceptions of control or their need to exert control.

Interestingly, only the residents at TMI opted to use both methods of rolling the dice (i.e., hand or dice) whereas, the control

subjects all used the dice cup. This finding is not trivial, because the TMI residents who spontaneously chose to use their hands to roll the dice apparently believed, as indicated by their comments, that this behavior would improve the contingency between behavioral input (i.e., rolling the dice by hand) and outcome on the dice task. Typical statements such as: "I can roll the dice better when I use my hands' or "When I used my hands to roll the dice I have more control over them", is further evidence of the TMI residents beliefs. Previous research by Baum and his colleagues had found other behavioral differences among the TMI residents, which included a reduced ability to find errors on proofreading tasks and performance decrements on an embedded figures task (Collins, Baum, & Singer, 1983; Davidson, Baum, & Collins).

Previous research on coping differences at TMI has shown that certain coping styles are associated with reducing the cognitive and behavioral decrements associated with the stress response (Baum, Fleming, & Singer, 1983; Collins, Baum, & Singer, 1983). Although no main effects for coping were noted in the present study, as were found in previous research (Baum, Fleming, Singer, 1983; Collins, Baum, Davidson, 1983), the sample size could have handicapped the possibility of finding these effects.

For example, out of the 56 subjects run through the study, 12 subjects at Three Mile Island and 10 subjects at Frederick were not classifiable as High- or Low-Control-Oriented copers since they did not meet the criteria for being included into either of these coping styles. As a result, 19 subjects from Three Mile Island and 15 subjects from the control group at Frederick were classified as using either a High-

Control-Oriented (HCO) or a Low-Control-Oriented (LCO) coping style. The resultant sample was adequate to show significant differences between groups on several variables. Of course, had the sample size been larger other effects may have also emerged. However, since this point is speculation, it must remain conjecture until verified or refuted by future research between these two groups.

It is no easy task to obtain a representative sample of people who were victimized after a disaster. Usually it is only those who have sought help because they were physically or psychologically affected that can be readily contacted. Additionally, numerous victims attempt to cope with their feelings by putting the whole event out of their mind. They desire no contacts that would remind them of the event. Consequently, obtaining large numbers of volunteers for disaster-oriented research can be a challenge. An even greater challenge is recruiting victims of a disaster to be research participants on a regular basis. Therefore, when a researcher seeks to study a group of victimized people 5 years after the event, every effort is made to obtain as large a sample as possible so meaningful inferences can be obtained.

The present study benefitted by being able to use an established subject pool from an ongoing longitudinal study that included residents of both the Three Mile Island area and from the control group in Frederick, Maryland. The coping styles used by many of these subjects had previously been studied and determined (Baum, Fleming, Singer, 1984; Collins, Baum & Singer, 1983), thereby allowing the present research to use the coping style categorization that was established from previous research. Of course, for methodological reasons it was necessary that the experimenter not be aware of a person's coping style, as this might

have biased some of the findings. Consequently, the experimenter was blind regarding the subject's previous style of coping. In order to further remove any potential interpretive bias it was decided that the experimenter would run all subjects at both groups, including those subjects who (it was later revealed) did not meet the High-Control-Oriented or Low-Control-Oriented coping criteria.

In spite of the advantageous situation of being able to use an established subject pool, the ideal sample size for this study is larger. However, in performing field research the ideal sample size often remains elusive. The present research was no exception. This is neither an apology nor a justification, but merely a reflection regarding the numerous obstacles and limitations which are experienced in conducting field research.

Despite the inherent obstacles and challenges associated with field research, it should be noted that the laboratory setting was inadequate for studying the psychological effects of interest associated with chronic stress that occurs daily in this naturalistic field setting. The naturalistic study is superior to the laboratory study for purposes because the latter is not suited (for ethical, logistical, or inference reasons) for exploring the relationships that occur during their daily routines. Thus, the present field research benefitted from being conducted during the subjects' daily routine. This permits the inference that the group differences noted on the acute tasks are probably associated with the different stress levels occurring within each group. For example, the residents living within the Three Mile Island area have been exposed to chronically stressful events associated

with the damaged nuclear power plant for over 5 years, whereas, the subjects at Frederick, Maryland only had to deal with the randomly occurring daily stressors which we all experience on an occasional basis.



## Summary and Conclusions

Stress has been defined as "the process by which environmental events threaten or challenge an organisms well-being and by which that organism responds to this threat" (Baum, Singer, & Baum, 1981). The three interactive components of the stress process are: a source, a transmission, and a response. The source of the stress response is a stressor, and has transmission characteristics which in turn are appraised by the organism. Depending upon the appraisal of the stressor, the stress response may be acute or chronic. The stressor in this research study was the chronic aftermath of the nuclear reactor accident at Three Mile Island (TMI).

Unlike many stressors, the nuclear accident at TMI was an acute stressor of unusual severity. Another unique aspect of the TMI disaster is that the stressor remains unresolved. The TMI area residents have been exposed to conflicting and confusing reports from the utility officials, politicians, and the media that resulted in an information crises. This information crises has resulted in a loss of credibility for these officials which remains even today. To further exacerbate the chronic stress at TMI, numerous rumors abound which serve as constant reminders of their plight.

Previous psychological research conducted as soon as was feasible following the TMI accident, not unsurprisingly, showed that the TMI residents reported themselves as stressed. (Bromet, 1980b; Dohrenwend et al., 1979; Houts et al., 1980; Flynn et al., 1979). Specifically the TMI residents were concerned about their physical and emotional health as a result of believing that they were exposed to radiation from the

damaged nuclear reactor. These studies detected an enhanced stress response among the TMI residents. As we know, the stress response involves a "whole body" response to the stressor. Consequently, other researchers, who have confined themselves to using telephone surveys to measure chronic stress at TMI, are not as informative or as generalizable as the field research conducted face to face in people's homes.

The accident and its aftermath at the Three Mile Island (TMI) nuclear power station is still stressful for the TMI area residents living within 5 miles of the damaged nuclear reactor (TMI-2) (Baum, Schaeffer, Lake, Fleming, & Collins, 1984; Baum, Gatchel, & Schaeffer, 1983; Collins, Baum, & Singer, 1983). Past research by Baum's research group has found that the TMI area residents exhibited greater emotional distress, had more task performance decrements, higher levels of urinary catecholamines and higher blood pressure than did subjects drawn from several control locations (Baum, et al., In Press; Baum, Gatchel, Fleming, & Lake, 1981; Collins, et al., 1983; Collins & Baum, 1982). More importantly, it was found that some TMI area residents were consistently high on all of these stress measures while others were consistently low. This selective susceptibility to stress was reported as being related to several variables that influenced appraisal or reflected its outcome. These variables include perceptions of control, specific modes of coping, and attributions of responsibility, and were all associated with stress responding at TMI (Baum, et al., In Press; Collins et al., 1983; Davidson, Baum, & Collins, 1983).

Based on the consistent clustering of subjects on these predictor variables, the TMI area residents were classified as either High-Control-

Oriented (HCO)-copers or Low-Control-Oriented (LCO)-copers. HCO-copers were defined as those who appear to seek out control over their environment by using an emotional and self-blame oriented coping style, while LCO-copers did not use this type of coping. Previous literature suggests that a person's expectation of success and persistence on a task is greater when people are given the opportunity to become involved in a task (Langer, 1975; Wortman, 1975). Langer (1975) has shown that when people could link their involvement to an outcome -- even though that outcome was pure chance (i.e., a lottery ticket) subjects persisted longer than when they were not as involved in the task.

The present field research was specifically conducted to investigate the possibility that the chronically stressful aftermath of the TMI accident would result in detectable stress effects which would be exhibited as decreased persistence on chance tasks. This field research was conducted five years after the occurrence of the nuclear reactor accident at Three Mile Island.

This study manipulated the subjects involvement (high and low) on two chance tasks, to determine if persistence differences would be found to exist as a function of involvement as well as between residences (TMI and Fredrick). In the high involvement condition the subject started the random number generator and rolled the dice whereas, in the low involvement condition the experimenter performed these tasks. In both involvement conditions the subject attempted to predict the next 2-digit number that would appear on either a dice task or on the Calculator (random number generator task).

As a group the residents of TMI showed less persistence (i.e., fewer trials) on the chance tasks than did the control residents.

Subjects at both locations (TMI and Fred) persisted less in the low involvement condition than when highly involved.

The manner in which the dice were thrown (dice cup or hand) was shown to be significantly different between locations with more people at TMI rolling the dice by hand than at Frederick. In fact, no one at Frederick rolled the dice by hand. Furthermore, persistence associated with the method of dice rolling was shown to interact with coping styles.

The persistence differences that were found between the TMI residents and the Frederick residents indicates that chronic stress exists at TMI five years after the accident. The subjects level of personal participation with their situation and their style of coping were shown to influence their persistence on challenging tasks.

## Appendix A

### Analysis of Variance Summary Tables

The following summary tables contain the analysis of variance tables for the data on all the variables. Table s-1 summarizes persistence associated with a repeated measures analysis of variance on involvement by residence and coping style, table s-2 serves to summarize the persistence data for a repeated measures analysis of variance on only those subjects who persisted beyond the required four trials and for which group and coping data were available. Table s-3 is a compilation of the analysis of variance for dice persistence among the TMI area residents by coping, involvement, and method of dice rolling. All analyses were performed using the Statistical Package for the Social Sciences (SPSS) except for the repeated measures analyses which used the Biomedical Data Package (BMDP). The programs assume homogeneity of variance and perform all statistical operations according to steps set down in typical analyses of variance formula. All qualifications appear below each summary table. Effects are noted as follows:

\*\*\* =  $p < .001$

\*\* =  $p < .01$

\* =  $p < .05$

Table s-1

Repeated Measures Analysis of Variance for Persistence  
by Residence and Coping Style

Source	Sum of Squares	DF	Mean Square	F-Test	p value
Between Subjects					
Var (1)	91.31	1	91.31	3.37	0.076
Var (2)	12.41	1	12.41	0.46	0.504
1 x 2	16.54	1	16.54	0.61	0.440
Error	811.91	30	27.06		
Within Subjects					
R	140.05	1	140.05	33.75	0.001
R1	0.33	1	0.33	0.08	0.781
R2	2.81	1	2.81	0.68	0.417
R12	0.04	1	0.04	0.01	0.914
Error	124.50	30	4.15		
Total	1199.90	67			

Classifying factors:

Var(1) Group (TMI vs Fred)

Var(2) Coping Style (HCO vs LCO)

R Repeated Measures on Involvement

Table s-2

Repeated Measures Analysis of Variance for Involvement  
(On Subjects Persisting More than Four Trials)

Source	Sum of Squares	DF	Mean Square	F-Test	p value
<b>Between Subjects</b>					
Var(1)	113.20	1	113.20	5.24*	0.032
Var(2)	15.62	1	15.62	0.72	0.403
1 x 2	57.76	1	57.76	2.67	0.115
Error	496.67	23	21.59		
<b>Within Subjects</b>					
R	177.17	1	177.17	47.09	0.001
R1	0.45	1	0.45	0.12	0.731
R2	2.51	1	2.51	0.67	0.422
R12	2.12	1	2.12	0.56	0.461
Error	86.52	23	3.76		
Total	952.02	53			

**Classifying factors:**

Var(1) Group (TMI vs Fred)

Var(2) Coping Style (HCO vs LCO)

R Repeated Measures on Involvement

Table s-3

Summary of 3-way Analysis of Variance at TMI on Dice  
Persistence by Coping, Involvement, and Method of Dice Rolling

Source	Sum of Squares	DF	Mean Square	F-Test	p value
Var(2)	0.63	1	0.63	0.07	0.801
Var(3)	52.53	1	52.53	5.58*	0.038
Var(4)	1.16	1	1.16	0.12	0.732
2-WAY INTERACTIONS					
2 x 3	0.75	1	0.75	0.08	0.782
3 x 4	13.00	1	13.00	1.38	0.265
2 x 4	51.34	1	51.34	5.45*	0.040
3-WAY INTERACTIONS					
2 x 3 x 4	43.51	1	43.51	4.62	0.055
Error	103.58	11	9.41		

Classifying factors:

Var(2) Coping Style (HCO vs LCO)

Var(3) Level of Involvement on the Dice Task

Var(4) Method of Throwing the Dice



### Questionnaire

This questionnaire was administered before the chance tasks were given.

Below you will find a series of statements. Please read each statement carefully and respond to it by expressing the extent to which you believe the statement applies to you. For all items a response from 1 to 7 is required. Use the number that best reflects your belief when the scale is defined as follows:

1. The statement doesn't apply to me at all.
2. The statement doesn't apply to me.
3. Most often the statement does not apply.
4. I am unsure about whether or not the statement applies to me, or it applies to me about half the time.
5. The statement applies more often than not.
6. The statement usually applies to me.
7. The statement always applies to me.

It is important that you respond to all items.

1. I try to avoid situations where other people tell me what to do.

1      2      3      4      5      6      7

2. I enjoy having control over my own destiny.

1      2      3      4      5      6      7

3. I would rather someone else took over the leadership role when I'm involved in a group project.
- 1      2      3      4      5      6      7
4. I like to get a good idea of what a job is all about before I begin.
- 1      2      3      4      5      6      7
5. There are many situations in which I would prefer only one choice rather than having to make a decision.
- 1      2      3      4      5      6      7
6. I am able to do things as well as most other people.
- 1      2      3      4      5      6      7
7. I would prefer to be a leader rather than a follower.
- 1      2      3      4      5      6      7
8. Others usually know what is best for me.
- 1      2      3      4      5      6      7
9. When I see a problem I prefer to do something about it rather than sit by and let it continue.
- 1      2      3      4      5      6      7
10. I like to gamble and play games of chance.
- 1      2      3      4      5      6      7
11. I don't mind other people scheduling my time.
- 1      2      3      4      5      6      7
12. I usually push an elevator button even if it is lighted indicating that someone else has already pushed it.
- 1      2      3      4      5      6      7
13. Generally, people deserve what they get and get what they deserve.
- 1      2      3      4      5      6      7

14. I prefer to avoid situations where someone else has to tell me what it is I should be going.

1    2    3    4    5    6    7

15. When it comes to orders, I would rather give them than receive them.

1    2    3    4    5    6    7

16. I enjoy making my own decisions.

1    2    3    4    5    6    7

17. I like to wait and see if someone else is going to solve a problem so that I don't have to be bothered by it.

1    2    3    4    5    6    7

18. I prefer a job where I have a lot of control over what I do and when I do it.

1    2    3    4    5    6    7

19. I consider myself to be generally more capable of handling situations than others are.

1    2    3    4    5    6    7

20. I'd rather run my own business and make my own mistakes than listen to someone else's orders.

1    2    3    4    5    6    7

21. If you have a choice of two lines at the supermarket, how likely is it that you would end up getting in the slower line?

1    2    3    4    5    6    7

very unlikely

very likely

22. If you park your car in the street and  $\frac{1}{2}$  of the cars get splattered, how likely is it that your car will have gotten splattered?

1    2    3    4    5    6    7

very unlikely

very likely

23. How good are you at predicting outcomes like tossing a coin and determining heads or tails?

1    2    3    4    5    6    7

very bad

very good

24. How much influence do you feel you have over a coin toss?

1    2    3    4    5    6    7

very little

very much

25. How confident are you that your first prediction will be correct?

1    2    3    4    5    6    7

very little

very much

## Questionnaire

This questionnaire was given just before the  
chance tasks were administered.

1. How confident do you feel that your next prediction will be  
correct?

1    2    3    4    5    6    7

very little

very much

2. I am able to do most things as well as most other people

1    2    3    4    5    6    7

very uncertain

very certain

3. Would you like to attempt to predict more numbers?

yes \_\_\_\_\_ no \_\_\_\_\_

### Questionnaire

This questionnaire was given only if subjects indicated on the previous questionnaire that they would like to attempt to predict more numbers.

1. How confident are you that your first prediction will be correct?

1    2    3    4    5    6    7

very

very

unconfident

confident

## Questionnaire

This questionnaire was given after the fourth trial of the second chance task.

1. Would you like to attempt to predict more numbers?

yes \_\_\_\_\_ no \_\_\_\_\_

If "yes" to question 1 above, then answer question 2 below.

2. How confident do you feel that your next prediction would be correct?

1    2    3    4    5    6    7

very

very

unconfident

confident

## Questionnaire

This questionnaire was administered after  
the second chance task was completed and  
before the debriefing was given.

1. Which task do you feel you were more involved in?

Dice \_\_\_\_\_ Number Generator \_\_\_\_\_

On the number tasks you have just completed, please indicate how  
much you attribute your performance to each of the following:

2. My performance on the number picking task was a result of my  
skill at picking numbers.

1    2    3    4    5    6    7

strongly disagree

strongly agree

3. My performance on the number picking task was a result of  
chance.

1    2    3    4    5    6    7

strongly disagree

strongly agree

4. My performance on the number picking task was a result of how  
much effort I expended.

1    2    3    4    5    6    7

strongly disagree

strongly agree

5. My performance on the number picking tasks was a result of how  
hard the task was.

1    2    3    4    5    6    7

strongly disagree

strongly agree



6. How many correct predictions do you feel you would have made on the next 100 trials?

---

1 2 3 4 5 6 7

very little

very much

8. I feel that I'm a person of worth, at least on an equal basis with others.

1 2 3 4 5 6 7

very false

very true

9. How confident are you that you would do better if you performed these task again?

1 2 3 4 5 6 7

very little

very much

10. How much fun was this experiment?

1 2 3 4 5 6 7

very little

very much

11. How many correct predictions do you feel the experimenter would have made on the next 100 trials?

---

1 2 3 4 5 6 7

very little

very much

13. How anxiety arousing was this experiment?

1 2 3 4 5 6 7

very little

very much

14. How much control did you have over this experiment?

1 2 3 4 5 6 7

very little

very much

15. How frustrating was this experiment?

1 2 3 4 5 6 7

very little

very much

16. How challenging was the dice task?

1 2 3 4 5 6 7

very little

very much

17. How challenging was the number generator task?

1 2 3 4 5 6 7

very little

very much

18. How well do you think others have done on these tasks?

1 2 3 4 5 6 7

others did better

I did better

than I did

than others

19. If there is a coke machine that works only  $\frac{1}{2}$  of the time, how likely is it that after you inserted your money that you would get a coke?

1 2 3 4 5 6 7

very unlikely

very likely

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PERSISTENCE DIFFERENCES BETWEEN THE THREE MILE ISLAND  
RESIDENTS AND A CONTROL GROUP(U) AIR FORCE INST OF TECH  
WRIGHT-PATTERSON AFB OH D L COLLINS MAY 84  
AFIT/CI/NR-84-36D

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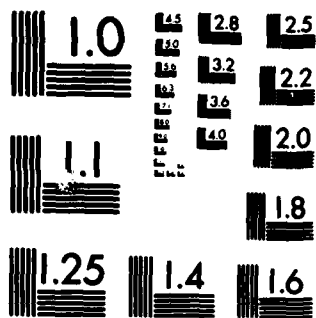
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MICROCOPY RESOLUTION TEST CHART  
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